THE ECOLOGY OF HONEY CREEK, OKLAHOMA: THE DOWNSTREAM DRIFT OF THREE SPECIES OF AQUATIC DRYOPOID BEETLES (COLEOPTERA: DRYOPOIDEA)[1]

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ABSTRACT: Daily adult and larval *Lutrochus luteus* LeConte drift was highest during May and June 1973, while larval benthic densities were maximal during late summer, 1972. Drifting *Dubiraphia vittata* (Melsh.) and *Microcylloepus pusillus* LeConte adults were most prevalent during spring and summer, 1973. Diel adult drift rates for all three species were characteristically nocturnal with a significant pre-midnight peak of activity, while *L. luteus* larvae were most active during the midnight hours.

DESCRIPTORS: drift, benthos, dryopoid beetles

Practically all information on the ecology of midwestern, aquatic dryopoid beetles has been presented as a series of qualitative observations by Brown and associates (Sanderson and Brown, 1956; Brown and Shoemake, 1964b; Brown, 1966; Brown and Murvosh, 1970). This group of beetles typically inhabit unpolluted, fast moving streams where they are found attached to, or beneath, stones and allochthonous detritus. Several genera such as *Lutrochus* (Limnichidae), and *Dubiraphia* and *Microcylloepus* (Elmidae) are frequently associated with travertine streams throughout their distribution and have been reported from Honey Creek, Oklahoma (Sanderson and Brown, 1956; Brown, 1956, 1960; Brown and Shoemake, 1964a; Reisen 1975a). Although the downstream drifting behavior of many stream insects is well understood (Waters, 1972; Hynes, 1972, Bournaud and Thibault, 1973), no quantitative observations have been reported on the diel or temporal drifting patterns of these genera of dryopoid beetles with the possible exception of Bishop and Hynes (1969) who listed *Dubiraphia* as a minor component of the autochthonous drift comprising 0.1% of the total.

During a study on the population ecology of simuliids at Honey Creek, Oklahoma, (Reisen, 1974, 1975b, 1977), dryopoid larvae and adults were routinely encountered in both benthic and drift samples. The purpose of the present report is to describe the temporal and diel patterns of those collections.

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Methods and Materials

Selected aspects of the ecology of Honey Creek including temporal patterns in physico-chemical conditions and periphyton abundance have been studied by Hornuff (1957) and Reisen (1974, 1975a and 1976b). All collections presented in the present report were made within the zone of travertine deposition between Bridal Veil and Turner Falls coinciding with those stations described by Reisen (1974, 1976b, 1977).

The drift sampling apparatus, collection procedures, sampling schedule, specimen sorting methodology and statistical analyses were the same as those used by Reisen (1974, 1976a, 1977). *Lutrochus luteus* Le Conte larvae were also frequently recovered from weekly bottom samples taken at 6 permanent stations situated at different riffles within the zone of travertine deposition (Reisen, 1976b). Single "best estimate" collections were made at each station with a modified Surber sampler (bottom area = 39.0 cm^2) averaged over the 6 stations, and expressed as the mean number of larvae per cm^2 of bottom area.

Results and Discussion

L. luteus larvae were recovered throughout the year in both benthic and drift samples with peak abundances observed during the warmer months of the year (Fig. 1 and 2a). Benthic densities on the riffles were highest during the late summer and early fall of 1972 when stream discharge was exceedingly low due to an extended rainless period. Larvae were frequently taken among *Simulium* populations in fast moving riffles practically devoid of periphyton (Reisen, 1977). Larval benthic density was negatively correlated with increases in stream discharge ($r = -0.399, P < 0.05$). However, larval downstream drift was maximized during the late spring of 1973 when rains were frequent, and the discharge was greater. These data would suggest that *L. luteus* larvae were susceptible to being washed away by increased discharge. In the study area, travertine deposition converted the normally 3-dimensional riffle habitat into a 2-dimensional space, reducing the fauna to those forms able to tolerate constant exposure to the current (e.g., Simuliidae, Hydropsychidae), or able to burrow into the substrate (e.g., Chironomidae). Drifting larvae probably consisted of individuals leaving protected microhabitats in search of food that were passively swept away by the current. Larval and adult drift were not correlated with larval benthic density ($r = -0.024$, $r = -0.115$, $P > 0.05$). Perhaps if benthic samples had been taken in more preferred microhabitats, a significant positive correlation may have been realized. Larval drift was correlated with periphyton abundance being highest during May and June, 1973 ($r = 0.605, P > 0.01$).

L. luteus apparently overwinters in the larval stage as adults were not

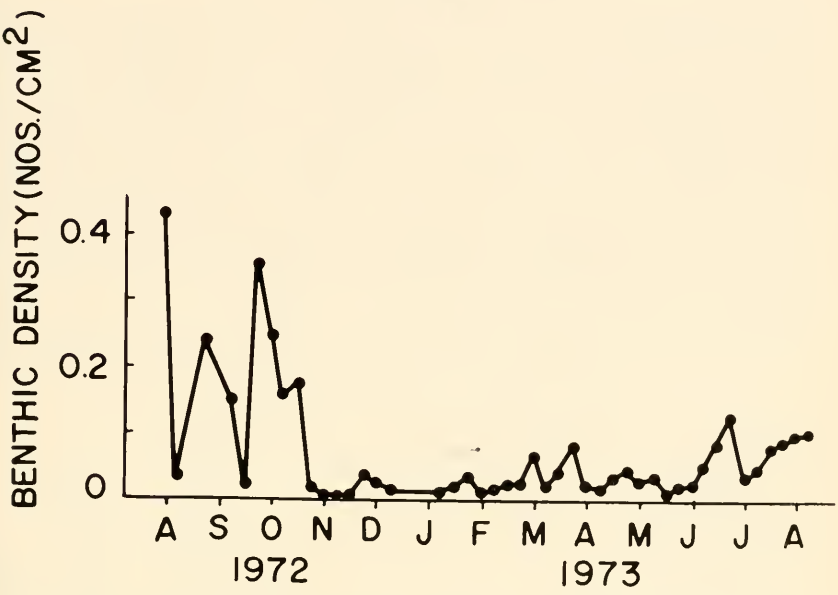

Figure 1. Weekly changes in the mean benthic density of *Lutrochus luteus* larvae collected at 6 riffles between Bridal Veil and Turner Falls.

collected from October through April (Fig. 2a). As the terrestrial pupae were not sampled during the present study, it was not ascertained if the winter was also spent as diapausing pupae. Peak adult drift occurred about 1 month after peak larval drift suggesting a single generation per year at Honey Creek (Fig. 2a). Adult drift rates were positively correlated with algal abundance ($r = 0.518$, $P < 0.05$) and rainfall ($r = 0.678$, $P < 0.01$), and presumably were a function of the effect of these factors on larval survivorship. Adults were encrusted with travertine to varying degrees suggesting the drifting population consisted of both newly emerged (unencrusted) and older (heavily encrusted) individuals. Locomotion by the heavily encrusted individuals was probably restricted to crawling, and drifting may provide a valuable downstream dispersion mechanism. In agreement with Brown and Murvosh (1970) adults were usually observed to be flying upstream presumably exemplifying Müller's recolonization cycle (Müller, 1954).

Dubiraphia vittata (Melsh) and *Microcylloepus pusillus* Le Conte adults were most prevalent in the drift during the spring and summer of 1973 (Fig. 2b). *Dubiraphia* larvae were rarely encountered during this investigation and presumably remained hidden within the dense *Myriophyllum* beds which

abounded in most pools in Honey Creek (Reisen, 1975a). Adults were also infrequently collected among the *Myriophyllum* but were abundant in drift samples (Fig. 2b). *M. pusillus* larvae and adults were occasionally encountered in benthic samples, but not frequently enough to describe seasonal abundance patterns. Larvae were rare in drift samples. Drifting *M. pusillus* adults were most abundant during the summer of 1973 (Fig. 2b) and were positively correlated with increasing rainfall ($r = 0.669$, $P < 0.01$). It would appear from the adult drift rate that there were possibly two adult emergences per year, one in early summer and a second in late summer or fall. Variations in environmental conditions in 1972 and 1973 (Reisen, 1976b), may have altered the magnitude and timing of these emergences.

The diel drift patterns of the adult dryopoids was characteristically

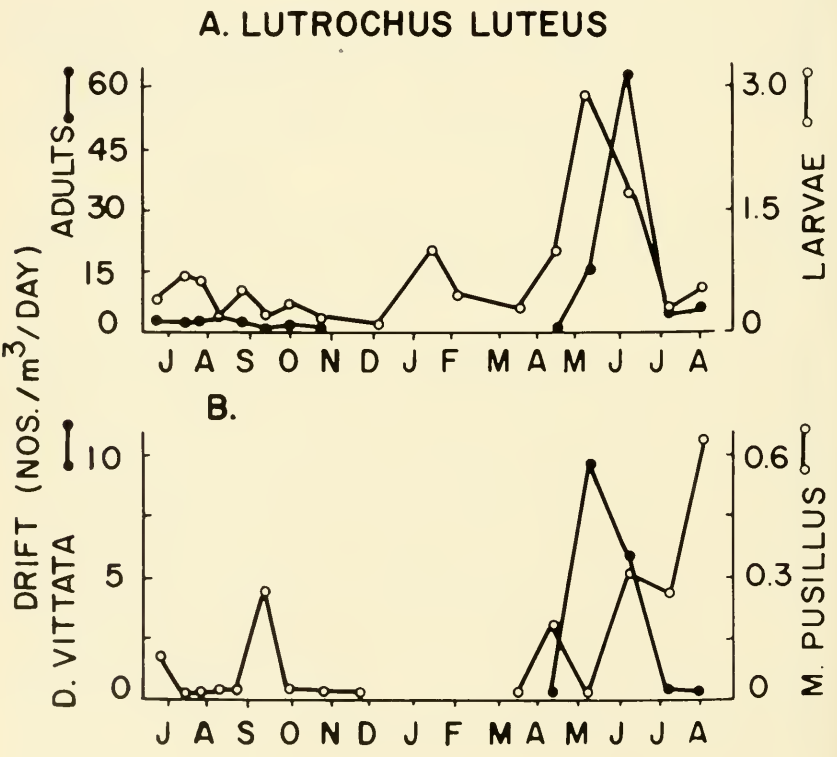

Figure 2. Temporal changes in the mean daily drift rate of A. *Lutrochus luteus* larvae and adults, and B. *Dubiraphia vittata* and *Microcylloepus pusillus* adults collected at 2 stations from 8 July 1972 through 15 August 1973.

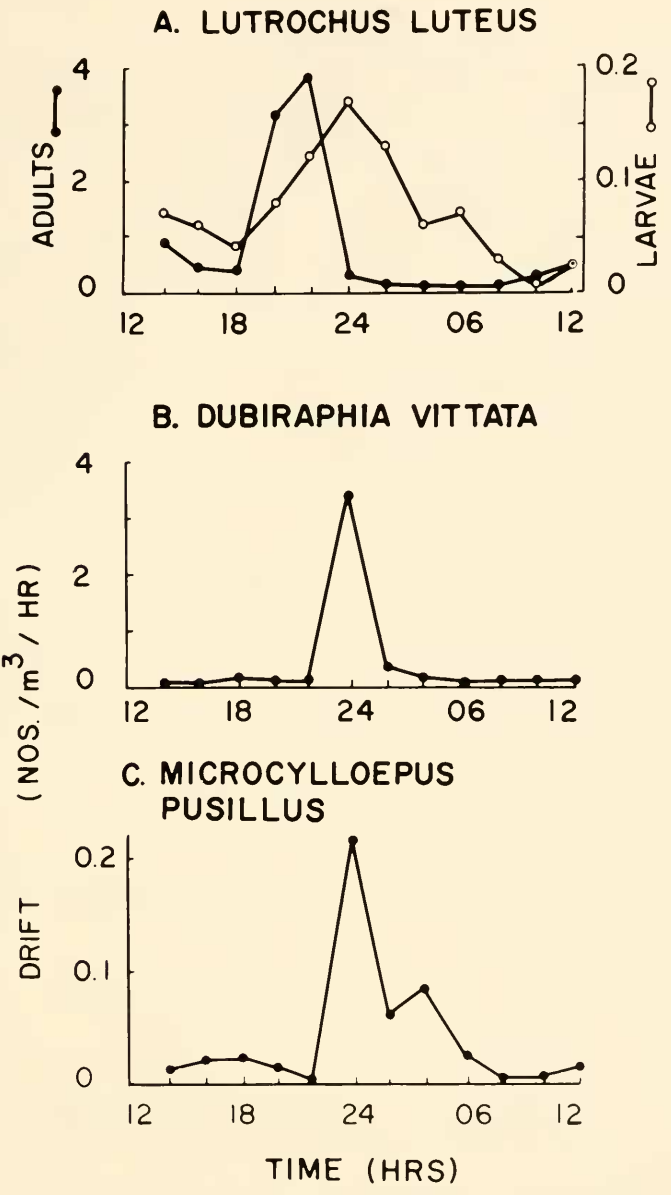

Figure 3. Diel changes in the mean hourly drift rate averaged over 2 stations and successive 24 hour studies during peak abundance: A. *Lutrochus luteus* adults (n = 9) and larvae (n = 11). B. *Dubiraphia vittata* adults (n = 4), and C. *Microcylloepus pusillus* adults (n = 2), where n = number of 24 hour studies included.

nocturnal with a significant ($P < 0.05$) bigeminous (pre-midnight) peak (Fig. 3) (Bournaud and Thibault, 1973), agreeing with the reported drift patterns of other dryopoid genera (e.g., *Helmis (=Elmis)*, Elliott and Minshall, 1968, and Elliott, 1967; *Optioservus, Cleptelmis,* and *Lara,* Brusven, 1970; and *Elmis,* Müller, 1970). Most drift occurred between 2200 and 2400 hours for *D. vittata* and *M. pusillus,* and between 1800 and 2200 for *L. luteus.* Since sunset during the months of greatest drift (Fig. 2) was never later than 1949 hours central standard time, it seemed improbable that *D. vittata* and *M. pusillus* drift were directly entrained changes in illumination during dusk. Conversely, adult *L. luteus* were apparently stimulated by the light-off stimulus with increased drift rates observed just after dusk. Increased drift was presumably related to increased adult activity, perhaps the entering of the adults into the water in search of food. *L. luteus* larval drift gradually increased with the onset of darkness and was maximal between 2000 and 0200 hours. Increases in larval drift were presumably related to periods of increased periphyton grazing, predisposing the larvae to being washed away by the current.

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